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Screening of commercially available cauliflower genotypes against *Pieris brassicae* ovipostion

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Abstract
Experiments on ten commercially available genotypes of cauliflower, i.e. White corona, Snow mystique, Snow grece, Local, Clima, 5340, Sydney, Snow crown, White magic and AX-2034 were conducted during 2012-2014 at the Agricultural Research Institute Tarnab, Peshawar to screen out the commercially available cauliflower genotypes against *Pieris brassicae* ovipostion. The results of field experiments revealed that maximum number of *Pieris brassicae* eggs plant^{-1} were recorded on White magic (276.50 eggs plant^{-1}) than any other studied genotype. And no egg laying were observed on Sydney and AX-2034.

Keywords: cauliflower, commercial genotypes, *P. brassicae,* ovipostion, Peshawar

1. Introduction
Cauliflower, *Brassica oleracea,* is one of the most popular and economical crop in Peshawar valley. The cauliflower contains more protein, potassium, phosphor, and some vitamins compared with white cabbage it is low in fat, but high in dietary fiber, foliate, water and vitamin C [26]. Pakistan is included in top ten cauliflower producing countries in the world. Cauliflower produce in 2011 was over 0.2 million tonnes/year [5]. In Peshawar valley the cauliflower crop at different stages of development is mostly attacked by cabbage butterfly (*Pieris brassicae* L.). *P. brassicae* showed variations in preferring different varieties of *Brassica spp* [1]. *P. brassicae* laid eggs in batches on upper and lower side of leaves of host plant [3]. It can lay 150 to 300 eggs [17]. The aim of our study was to evaluate commercially available cauliflower genotypes for oviposition resistance against *P. brassicae*. This would be helpful in evolving resistant varieties of cauliflower against *P. brassicae*.

2. Materials and Methods
The research studies on screening of commercially available cauliflower genotypes against *P. brassicae* oviposition was conducted at the Agricultural Research Institute Tarnab, Peshawar during 2012-2014. The research trial consisted of field experiment.

2.1 Preliminary field screening of cauliflower genotype
Healthy seedlings (about 3-4″ tall) of 10 commercially available genotypes of cauliflower, i.e. White corona, Snow mystique, Snow grace, Local, Clima, 5340, Sydney, Snow crown, White magic and AX-2034 were transplanted in the last week of September, 2012 and 2013 on ridges in separate plots each measuring 4 m x 2m. Plant to plant and row to row distance was kept at 45 cm and 75cm, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were 30 experimental plots and in each experimental plot there were 30 plants. Standard agronomic practices were applied to all the treatments throughout the crop growing season but no preventive measures were applied. The cauliflower genotypes were regularly inspected for egg laying of pest and data was recorded weekly from appearance of first egg laying till harvest of crop. In each experimental plot five healthy plants were randomly selected for data recording. Total number of eggs on upper and lower leaf surfaces was calculated as eggs plant^{-1}.

3. Results
3.1 Screening of commercially available cauliflower genotypes against *P. brassicae* oviposition during 2012-14.
The mean number of *P. brassicae* eggs plant^{-1} on different Cauliflower varieties during 2012-13 and 2013-14 is given in Table 1. During 2012-13 significantly more eggs were recorded on White magic (408.33 eggs plant^{-1}), while less number of eggs were recorded on Snow

mystique (18 eggs plant^{-1}). No eggs were recorded on White corona, Clima, 5340, Sydney and AX-2034. In 2013-14 *P. brassicae* laid significantly more eggs on Local varieties (205.33 eggs plant^{-1}) and less eggs were laid on 5340 (12.32 eggs plant^{-1}). No eggs were found on Sydney, Snow crown and AX-2034.

Averaging the *P. brassicae* oviposition of two years 2012-14 (Table 1) showed that maximum number of egg was observed on White magic (276.50 eggs plant^{-1}) and minimum eggs were recorded on White corona (9 eggs plant^{-1}). The results further revealed that *P. brassicae* laid significantly more eggs in 2012-13 (80.50 eggs plant^{-1}) than 2013-14 (61.16 eggs plant^{-1}). The interaction between years and genotypes was significant ($p \leq 0.05$).

Fig. 1. shows that egg laying started on 9th November and ended on 22nd Feb. on Snow Greece there were two peaks (on 16th November and 18th January). On Local varieties egg laying peaked 16th Nov., 7th Dec., 28th Dec., 11th Jan and declined afterwards. On Snow Mystique higher number of eggs were recorded on 14th Dec. On White Magic egg laying peaked twice, on 11th Jan and 15th Feb. On Snow Crown egg laying peaked singly on 4th Jan.

Table 1: Mean number of *Pieris brassicae* eggs plant^{-1} on 10 cauliflower genotypes during 2012-14.

Genotype	Mean number of eggs plant^{-1}		
	2012-13	**2013-14**	**Mean (2012-14)**
White Corona	0.00 f	18.00 f	9.00 g
Snow Mystique	18.00 e	81.00 d	49.50 d
Snow Greece	153.33 c	60.33 e	106.83 c
Local	171.67 b	205.33 a	188.50 b
Clima	0.00 f	90.00 c	45.00 e
5340	0.00 f	12.33g	6.16 g
Sydney	0.00 f	0.00 h	0.00 h
Snow Crown	53.66 d	0.00 h	26.83 f
White Magic	408.33 a	144.67 b	276.50 a
AX-2034	0.00 f	0.00 h	0.00 h
LSD (0.05)	5.9569	5.8739	4.2122
Years			
2012-13			80.50 a
2013-14			61.16 b
Significance level			*
Interaction			Significance level
Year x Genotype			**

Means in columns with similar letters are non-significantly different at α =0.05 (LSD test).

** Significant at $P \leq 0.01$

* Significant at $P \leq 0.05$

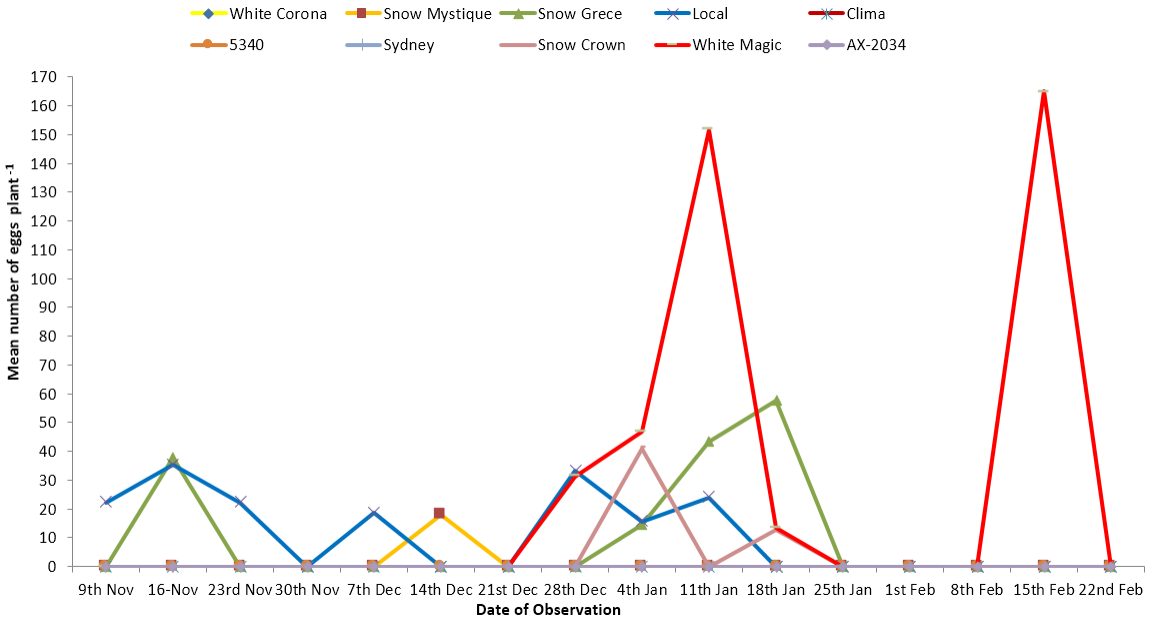

Fig 1: Oviposition of *Pieris brassicae* on various cauliflower genotypes during 2012-13.

In 2013-14, *P. brassicae* egg lying started on 4th Oct, fluctuated afterwards and ended on 24th Jan (Fig. 2). On Local genotype egg laying started on 11th Oct, increased abruptly on 18th Oct, peaked on 1st Nov, declined afterwards, but peaked again on 6th Dec, and declined afterwards. On Snow Mystique egg lying peaked three times on 22nd Nov, 13th Dec and 17th

Jan. On Snow Greece egg laying peaked twice, on 6th and 20th Dec. Egg laying on Clima started on 4th Oct, peaked on 25th Oct, declined abruptly but slightly increased to its second peak, and diminished afterwards. There was a single peak of 5340 eggs on 1st Nov.

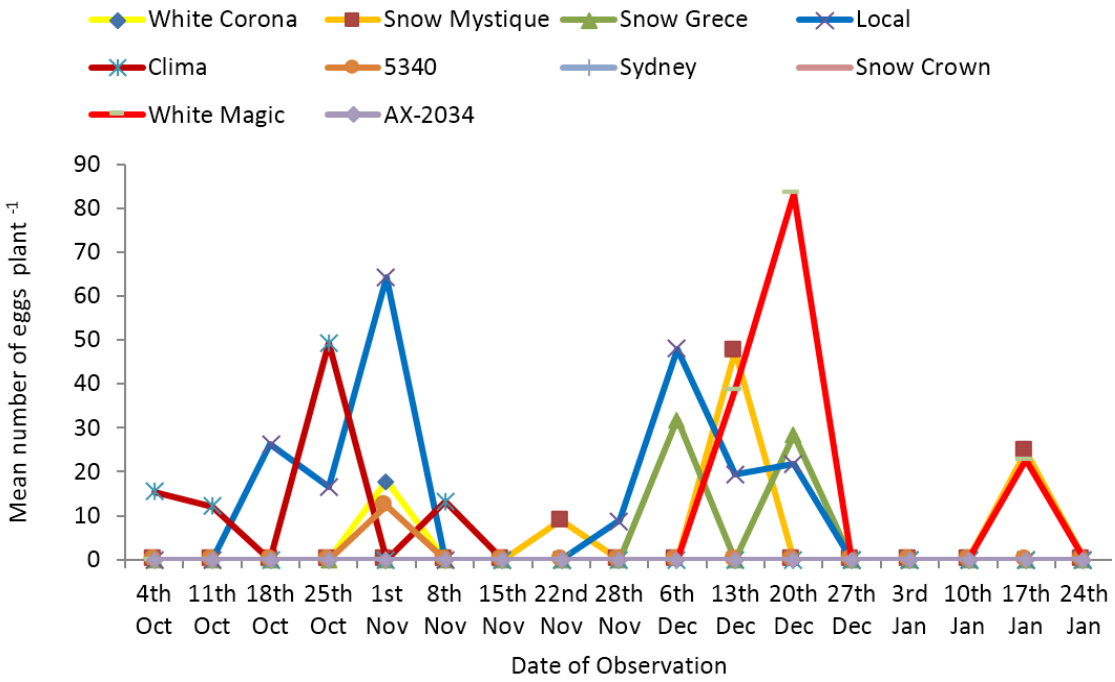

Fig 2: Oviposition of *Pieris brassicae* on various cauliflower genotypes during 2013-14.

3.2 Oviposition trend of *P. brassicae* on cauliflower during 2012-13

P. brassicae oviposition recorded on different dates during 2012-13 was significantly different at $p \leq 0.05$ (Fig. 3). Oviposition of *P. brassicae* on 10 cauliflower genotypes started on 9th Nov (23.33 eggs plant^{-1}) and reached to 1st peak on 16th Nov (73 eggs plant^{-1}) and then declined. Egg laying was observed again on 7th Dec and 14th Dec but no eggs were recorded in the next weeks. On 28th Dec egg laying was observed again, its density increased in next two weeks and attained its peak (219 eggs plant^{-1}) on 11th January. Next week its density gradually decreased and no egg laying was recorded from 25th Jan to 8th Feb. On 15th February it attained 2nd peak (165 eggs plant^{-1}) but suddenly declined afterwards.

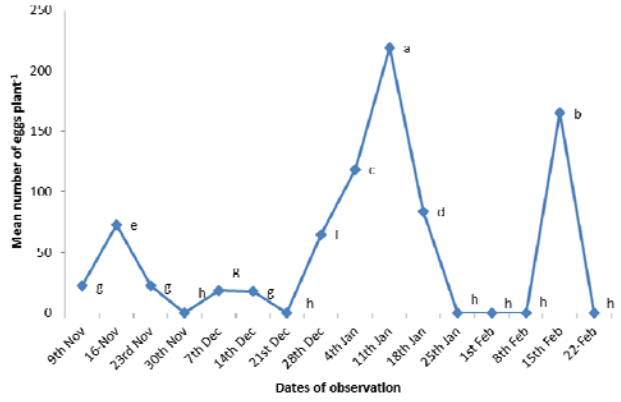

Fig 3: Oviposition trend of *Pieris brassicae* on cauliflower crop during 2012-13.

3.2.1 Oviposition trend of *P. brassicae* on cauliflower during 2013-14

In 2013-14 *P. brassicae* oviposition started on 4th Oct, it reached to its first peak on 25th Oct, declined till 15th Nov and increased to its second peak on 20th Dec (Fig. 4). No egg laying was recorded from 27 Dec to 10th Jan. Another small peak of eggs was recorded on 17th Jan, 2014.

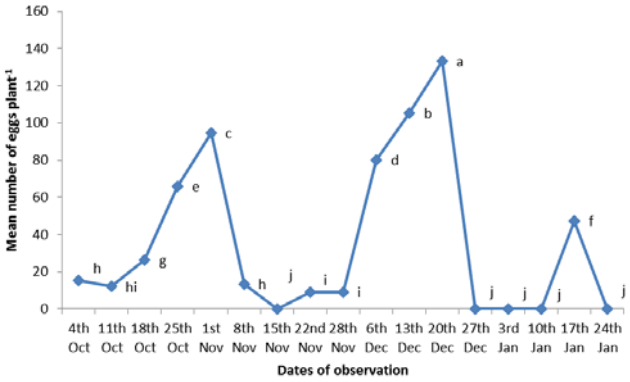

Fig 4: Oviposition trend of *Pieris brassicae* on cauliflower crop during 2013-14**.**

4. Discussion

The present study aimed to screen out the commercially available cauliflower genotypes against *P. brassicae* ovipostion. The insect pest and host plant cauliflower were investigated for consecutive two years in 2012-14.

Screening of commercially available cauliflower genotypes against *P. brassicae* oviposition during 2012-14.

Selection of host plant is a behavioral process and is regulated by chemoreception [11]. Good site selection for oviposition is a challenging task for female and her decision affect the profound consequences of her offspring [10].

P. brassicae laid eggs in clusters mostly on underside of leaves and occasionally on upper side of leaves [15]. The number of eggs per cluster can vary from 7- 105 [3, 12] and 25-250 [15] but on average there are between 30 and 50 eggs per batch [6]. In our experiment we observed 7 -218 eggs and 9-250 eggs per cluster during 2012-13 and 2013-14, respectively. *P. brassicae* oviposition was varied significantly on 10 cauliflower varieties. Significantly higher number of eggs (276.50 eggs plant^{-1}) were recorded on White magic and significantly lower number of eggs (9 eggs plant^{-1}) were recorded on White corona while no eggs were observed on Sydney and AX-2034. Some earlier researchers have recorded variable number of eggs by *P. brassicae* on cauliflower plant^{-1}, e.g. 2–195 eggs [7]; 36.11 eggs [23]; 17–35 eggs [4]; 29.66 eggs [24]. While *P. brassicae* female did not lay eggs on varieties Parel and Golden Acre [14]. Some scientists predicted that host plant resistance decreased fecundity of the *P. brassicae* [18].

The variation in oviposition may be due to physical plant characters, especially the plant height and leaf length chemical factor of plants. Our result showed that cauliflower varieties with maximum plant height and leaf length received maximum number of *P. brassicae* egg as compared to varieties with less plant height and leaf length. Some scientists found that butterfly oviposition is influenced by plant size and large plants are visually conspicuous so receive more eggs than small plants [22]. Late variety 'Krautkaizer' has biggest leaves and was overwhelmingly preferred for oviposition by *P. brassicae* [14].

The most significant factors for selection of suitable oviposition site are wax layer thickness, physiological age of plant, and biochemical composition of leaf [2]. *Pieris* spp. prefer greener color foliage with higher content of water and nitrogen [16, 27].

Selection of host plant by *P. brassicae* for oviposition based on presence of glucosinolates. The glucosinolate concentrations and composition vary within and between species of the food plants and different organs and tissue and different stages of plants. By increasing the fertilization of plant, foliar nitrogen and water content increases but glucosinolate content decreases [20]. Cabbage plants with higher content of volatile allyl nitriles are more attractive for *P. brassicae* oviposition [19].

Oviposition trend of *P. brassicae* on cauliflower

In the present study fluctuation in *P. brassicae* oviposition was observed in cauliflower ecosystem in Tarnab, Peshawar during 2012-2014. *P. brassicae* oviposition started on cauliflower genotypes on Nov 9th and Oct 4th and continued till Feb 22nd and Jan 24th during 2012-13 and 2013-14, respectively.

P. brassicae is active from Nov. to June in Peshawar, Charsadda and Mingora- Swat. Mating occurs on the day of emergence or on the next day. Repeated mating was observed which lasted 10-15 minutes [15]. But in our study mating took 30 minutes to 1 hour. Oviposition was observed after 3 to 4 days of mating and eggs were laid in batches [15]. The fluctuation in oviposition during the present study might be due to variation in abiotic factors specially temperature, relative humidity, wind speed, rain fall and sunlight duration. Some scientists reported that *P. brassicae* butterflies are active when the sun shines and temperature is high, otherwise it remain inactive and hide under leaves or other shelters [9, 21].

P. brassicae is widely distributed and destructive pest among all Lepidoptera pest attack on cole crops [8]. Its population usually fluctuates during different growing seasons of crucifers in different years [25]. *P. brassicae* population reached to its peak in every five to seven years, after which there is an abrupt decrease in its abundance [13]. In Pakistan *P. brassicae* occur at an altitude of 200m – 2000m and is mostly distributed in Peshawar, Charsadda, Rawalpindi, Abbottabad, Quatta and Sialkot [15]. It migrates from plain to hills in May, beginning of summer and from hills to plains in Sept., beginning of winter. Butterflies mate during their mass migration [9, 21].

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